# Socioeconomic Status, Permanent Income, and Fertility: A Latent Variable Approach

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# SOCIOECONOMIC STATUS, PERMANENT INCOME, AND FERTILITY: A LATENT VARIABLE APPROACH[*]

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# SOCIOECONOMIC STATUS, PERMANENT INCOME, AND FERTILITY: A LATENT VARIABLE APPROACH

## ABSTRACT

The role of socioeconomic status (SES) is central in sociological studies of almost any outcome, and sociologists have become increasingly interested in the long-term or permanent income aspect of SES. In this paper we examine how the components of SES, including permanent income, relate to fertility in developing countries. Permanent income is an abstract concept that is impossible to measure directly. Therefore, we employ a latent variable approach to studying its impact on fertility. We compare our results to the more common practice of using a proxy variable to measure permanent income and thereby investigate the consequences of not accounting for the measurement error that is inherent in proxies for permanent income. Using micro survey data from Ghana and Peru, we find that permanent income has a large, negative influence on fertility and that research must take the latent nature of permanent income into account in order to uncover that influence. Our results also suggest that when we take into account the measurement error of the proxies for permanent income, the estimates of the effects of some of the control variables are markedly different. Finally, we examine which of the common proxies used to measure permanent income most reliably capture the concept. Though our focus is on childbearing, our results have implications beyond this specific dependent variable, providing researchers with a sense of the sensitivity of microanalyses to the treatment of long-term economic status.

INTRODUCTION

Stratification lies at the core of sociology. Key to stratification's prominence is its role in understanding how a person or group's position in the stratification system affects their life chances such as their fertility, health, and mortality. Developing countries are a particularly important context for studying existing and evolving modes of stratification due to the penetration of development and westernization processes. The rise of market economies, the shift in occupational structures, and the changes in the distribution of resources occur at a more rapid pace than in post-industrial societies.

Among the biggest of these changes are those associated with income. Income is a complicated variable that comes in many forms. At a minimum we can distinguish between transitory and permanent income (Friedman 1957). Sociologists have begun to argue that more permanent economic status variables such as wealth or permanent income should be given a more prominent role in empirical analysis (Hauser and Warren 1997; Sørensen 2000; Spilerman 2000). The reasoning is that income at a particular time point is unlikely to be as influential as are long run or more stable measures of income or wealth. In this paper we use Friedman's concept of permanent income to examine its relation to fertility in two developing countries, Ghana and Peru.

In any country accurate measurement of permanent or transitory income is a challenge. This is particularly true in developing countries where markets are undeveloped or missing and barter can be more common than monetary exchanges. As a result, income is relatively little studied as a determinant of life chances, such as fertility, in developing countries. Instead, other aspects of socioeconomic status such as maternal education are more typically examined. Whether the omission of income is substantively justified because of its minor impact or due to the difficulty of measurement is rarely addressed. When researchers do include a measure of income in studies of developing

countries it often is not considered as distinct from other components of socioeconomic status. This makes it particularly difficult to determine whether income, itself, has a distinct impact on fertility, separate from other more common socioeconomic variables.

While income and SES affect most life chances, their effect on fertility in LDCs are particularly interesting for several reasons. First, high fertility levels in developing countries are expected to contribute nearly 2 billion people to the world population by 2125 (Bongaarts 1998). Second, fertility is a major life event for households that in turn affects many other outcomes such as maternal and child health (Lobao and Brown 1998; Khlat and Ronsman 2000; Klebanoff 1988). Third, fertility is the subject of a rich theoretical and empirical literature from sociology and related disciplines (e.g. Caldwell 1982; Crenshaw, Christenson, and Oakey 2001; Davis and Blake 1956). Finally, the negative fertility-income gradient observed both within and between countries, has been a continuing source of academic and policy dispute. Such disputes range from Malthus and his arguments against the Poor Laws in Victorian England to national governments and nongovernmental organizations debating global population policy in the forums of the decennial population conferences (McIntosh and Finkle 1995).

We have several purposes in this paper. First, we briefly discuss the substantive arguments about the relation between socioeconomic status, permanent income, and fertility. We highlight the distinction between transitory and stable components in SES with a particular emphasis on income. A second purpose is to formulate a model that relates several components of SES, including permanent income, to fertility in developing countries. In doing so, we recognize the impossibility of perfectly measuring an abstract concept such as permanent income and instead treat permanent income as a latent variable thereby controlling for the confounding effects of measurement error. The more typical approach to measuring permanent income is to employ a proxy, such as

household expenditures, which is likely to contain a good deal of measurement error. A third purpose is to compare the results from our latent variable approach to those of the more typical proxy variable analysis in terms of the estimated effects of permanent income and of the other explanatory variables. Our models also allow us to discover which proxy variables for permanent income are the best measures because we can determine which of the proxies have the highest reliabilities.

The analyses are based on data from Ghana and Peru, both collected during the mid to late-1980s. Analyzing data from two countries from different regions of the developing world that are at somewhat different levels of industrialization sheds some added light on the generalizability of our findings. While our focus is on the relationship between permanent income, SES, and fertility in developing countries, we believe this analysis provides insight into the importance of creating clear conceptual definitions of sociological variables and of treating the critical issue of measurement error in the operationalization process.

## SOCIOECONOMIC STATUS, PERMANENT INCOME, AND FERTILITY

Theoretical perspectives on fertility behavior can be understood in terms of the roles they attribute to individual opportunities, preferences, and norms. As Pollak and Watkins (1993) describe, most theories that aim to explain fertility focus on one of these factors. The role of SES or permanent income varies according to which of these models we use. One view generally understands SES or permanent income in terms of how it affects the opportunities that are available to individuals (Becker 1981; Willis 1973). This approach assumes that individual preferences are fixed and individual fertility decisions are constrained by the value of available resources. In contrast, another view suggests that SES or permanent income influences fertility by changing individual

preferences (Easterlin 1969; Namboodiri 1972). As Easterlin (1969) has argued, for example, SES may affect fertility preferences through its effect on consumption. Finally, many researchers posit a central role for the diffusion of norms on fertility (Axinn and Yabiku 2001; Cleland and Wilson 1987; Thornton 2001). In this case, SES or permanent income is likely to operate by accelerating the spread of new ideas. Thus, development and westernization, processes that are closely linked to SES or permanent income, are likely facilitated by increases in education and income.

Researchers who study childbearing determinants are faced with both an abundance of evidence about the strong inverse relationship between SES and fertility levels both across and within countries, and the complex and diverse models that aim to explain the reasons for this relationship. One approach to understanding this relationship is to attempt to explore the pathways through which SES or permanent income affects the intermediate variables, or proximate determinants, such as breastfeeding, contraception, abortion, and marriage, which themselves are the direct causes of fertility (Davis and Blake 1956). The difficulty is that many of the intermediate variables are not often available in surveys and some of these (e.g., marriage) are less influential determinants of fertility in today's less developed countries than they were in industrial countries during their demographic transitions. Though we recognize that most of these intermediate variables channel the effects of SES or permanent income on fertility, we do not attempt to include these intermediate variables but instead adopt a reduced-form approach, thereby concentrating on the total effect of the SES or permanent income variables on fertility.

Examining the complex relationship between SES or permanent income and fertility forces us to raise questions about the nature of SES and permanent income and their measurement. We have used SES and permanent income almost interchangeably in

the above discussion. In fact, there are a number of interesting similarities between these variables (Henretta and Campbell 1978; Rainwater 1974; Sørenson 2000; Williams and Collins 1995). Both concepts include arguments about how education, occupation, income, and wealth are interrelated. Socioeconomic status is sometimes viewed as a one-dimensional concept in which education, occupation, income, and wealth influence or reflect status. For example, researchers sometimes employ an index that combines two or more aspects of SES as in the Hollingshead index which combines education and occupation (Hollingshead and Redlich 1958). Interestingly, Friedman's (1957) classic definition of permanent income highlights many of these same variables as part of permanent income. "The permanent component [of income] is to be interpreted as reflecting the effect of those factors that the unit regards as determining its capital value or wealth: the nonhuman wealth it owns; the personal attributes of the earners in the unit, such as their training, ability, personality; the attributes of the economic activity of the earners, such as the occupation followed, the location of the economic activity, and so on" (Friedman 1957: 21).

In most cases, however, SES is simply a general expression that refers to its separate components, but each component is thought to have distinct effects. From this perspective, Weber (1946) and more contemporary empirical researchers (e.g., Blau and Duncan 1967; Featherman and Hauser 1977; Hauser & Warren 1997) have treated variables such as education, occupational prestige, and income as separate aspects of SES that can have distinct impacts.

Research stemming from the status attainment framework has been interested in the differential effects of the components of SES, and the status attainment framework can also be applied to fertility (Kasarda, Billy, and West 1986). For example, when women are educated, they may want fewer children because other opportunities for

enhancing their status are available and the opportunity costs of caring for children are higher (Axinn and Barber 2001; Willis 1973). To understand the effect of socioeconomic variables on fertility, we must first determine whether education and occupation have their effects mediated through permanent income or whether they have some direct influences on fertility. This is an avenue of research that has been little studied in the context of fertility.

The concepts of permanent income and SES depart slightly in the emphasis that permanent income gives to the distinction between long-term and transitory economic status. This distinction is particularly important for the income component of SES because education and occupation are less transitory in nature. That is, education remains relatively stable in adulthood, and although people experience job changes, occupational status also tends to be more stable than income. In developing countries where agricultural positions play such a prominent role, occupational status is particularly stable. In contrast to education and occupational status, income is more volatile. The definition of permanent income clearly distinguishes between those economic factors affecting behavior that are transitory from those like assets and education which should be relatively constant over the life course. The stable aspect of income is more likely to be influential for a variety of outcomes. As Sørenson states:

> It is important to consider not the cross-sectional distribution of income, but the long-term wealth profile that determines what economists call *permanent income and consumption patterns*. A person who obtains a higher education will orient her lifestyle not to the level of income in her youth, but to the long-term expected conditions corresponding to the wealth associated with her human capital (2000: 1539).

While socioeconomic status and class are more widely used in the sociological literature, permanent income has entered the sociological and demographic literature as a powerful predictor of a variety of behaviors and outcomes such as premarital childbearing (Wu 1996) and child health (Williams and Collins 1995). It is the more stable aspects of economic status, rather than economic status in any given year, which more strongly predicts children's mental health (McLeod and Shanahan 1993), cognitive development (Duncan, Brooks-Gunn, and Klebanov 1994), and behavioral problems (Takeuchi, Williams, and Adair 1991). In the context of fertility, researchers have also argued that the more stable aspects of income are more important than transitory income (Easterlin 1969; Mueller and Short 1983).

Despite a clear conceptual definition of permanent income, operationalization is less straightforward because it is not directly observable. In other words, no measure can perfectly capture the concept. Instead, permanent income is a latent variable. Empirical work most frequently operationalizes permanent income by using one or more proxy variables. Therefore, when the concept of permanent income is used to study fertility or other outcomes, researchers fail to take account of the latent nature of the concept. Consequently, researchers tend to ignore the contaminating effects of measurement error on the estimates of permanent income effects and the coefficients of the other explanatory variables in the analysis. It is well known that these biases not only undermine our attempts to understand the impact of the latent variable but they also may lead to inaccurate estimates of the effects of all other variables in our analysis (Bollen 1989).

Our review of the role of permanent income in influencing fertility reveals two questions that we will address. One is what are the effects of education, occupation, and income on fertility when these components of SES are simultaneously considered? For

instance, are all of the effects of education and occupational prestige mediated through permanent income? The second question is what effect does permanent income have on fertility when we take account of the measurement error in its proxies? As we answer this latter question, we will compare our results to the more common situation of using proxy variables without correcting for measurement error. The next section reviews common proxy measures of permanent income in the study of developing countries.

## PROXY VARIABLE MEASURES OF PERMANENT INCOME

Although occupation, education, and income are often viewed as separate components of SES, occupation and education are clearly important determinants of permanent income and as such are sometimes used as proxies for permanent income. For example, Houthakker (1957) and Mayer (1963) treat occupation as a proxy for permanent income in their evaluations of Friedman's hypothesis about the relationship between income and consumption. Hauser and Warren (1997) argue that occupation provides a useful proxy for permanent income because occupational status is more highly correlated over time than is income. Education is another important aspect of permanent income. A recent review cited maternal education to be the socioeconomic variable most commonly included in empirical studies of fertility and child health (Bollen, Glanville, and Stecklov 2001). Some researchers treat education as a proxy or determinant of permanent income. Yet many regard education as having an effect on fertility that is separate from its effect on permanent income. That is, it is believed to have a distinct impact through attitudes, knowledge, or behaviors (Axinn and Barber 2001; Caldwell 1982). A few studies have attempted to disentangle the effect of women's education from its association with household economic status with mixed results (Cleland and Rodriguez 1988; Martin and Juarez 1995; Rodriguez and Cleland 1981). In contrast to female education, husband's

education is not included in models of fertility as often, but when it is employed, it is often assumed to reflect the household's SES (e.g. Raftery, Lewis and Aghajanian 1995) and not necessarily more specific attitudes and knowledge (Bollen, Glanville and Stecklov 2001).

Measures of income from cross-sectional data are generally not viewed as adequate proxies for permanent income because of the volatility of income. Averaging earnings over several years is one way of dealing with income's variability over time (Behrman and Deolalikar 1990). However, income data in developing countries are often unreliable and rarely collected (Hentschel and Lanjouw 1996). In addition, given the predominance of non-market activities in most developing country economies, it is often difficult to estimate the monetary value of many labor market activities. Thus, direct measures of income are rare, and most research relies on information about consumption or ownership of consumer durable goods as proxy measures. Both of these types of proxies aim to tap into the more long term or permanent aspect of income.

In fact, many researchers prefer expenditures to income as a measure of long-run economic status (Deaton 1992). Following Friedman, the underlying assumption of using this measure is that long-term considerations, rather than current income, drive consumption decisions. Households borrow or save to smooth consumption across years to maintain a relatively consistent standard of living. Thus, household expenditures can serve as a proxy for permanent income (Deaton 1992). However this option is not without its limitations. Expenditure data are rarely collected in household surveys. Even when collected, researchers have questioned its reliability (Bouis 1994; Scott and Amenuvegbe 1990).

Because of the scarcity of data on income and expenditures, many researchers use information on ownership of consumer durable goods and/or housing quality to proxy for

permanent income. Information on these household characteristics is far easier to collect than both income and expenditure data. In particular, the Demographic and Health Surveys (DHS) and the earlier round of World Fertility Surveys (WFS) have collected these basic data in over 50 countries, making this information widely available.

Asset and housing quality measures are typically used to proxy permanent income in one of several ways: (1) as separate indicators, (2) as unweighted sums of indicators, or (3) as weighted sums of indicators. For example Montgomery, Gragnolati, Burke, and Parades (2000) include a series of consumer durable goods as separate indicators to analyze fertility and child health in several developing countries. A far more common approach is to employ an index of equally weighted items. For example, studies using DHS data often use a sum of the items available in the DHS, radio, television, refrigerator, bicycle, motorcycle, and car, as an indicator of household status. Rather than simply summing asset indicators, other recent research has employed weighted sums of assets. One way of weighting is to estimate the monetary value of each asset and then sum these (Dargent-Molina, James, Strogatz, and Savitz 1994). Filmer and Pritchett (1999; 2001) present an alternative approach where the asset weights are estimated using principal components analysis. The principal component approach provides a convenient weighting method, however, the weights have little theoretical foundation.

Three recent studies have evaluated the performance of one or more of these asset-based approaches. Montgomery et al's (2000) findings suggest that consumer durable goods entered as separate variables are weak proxies for expenditures but when tested as a group might reveal effects. Filmer and Prichett's (2001) analysis shows that the principal components score approach to weighting assets outperforms expenditure data. For example, they show that the principal components score better predicts school enrollments in India than a measure based on household expenditures. In addition,

Filmer and Pritchett suggest that the principal components score has less measurement error than consumption per capita. In a comparison of several different proxy approaches, Bollen, Glanville and Stecklov (2002) find that an unweighted sum of the number of items owned and the principal components score more strongly predict fertility than expenditures and alternative ways of weighting assets in an index. Although these other papers acknowledge the measurement error in their proxies for income, none of them treat permanent income as a latent variable in their models.

Our approach differs from this other work in that we introduce permanent income into our model and evaluate how the measurement error inherent in these proxies influences results. Furthermore, in evaluating the performance of proxies constructed from indexes of ownership of consumer durable goods, we compare several ways of weighting the individual items. Specifically, we compare the unweighted sum of the number of items owned and the principal components score to alternative weightings based on the monetary value of the goods.

*Summary and assessment*

In sum, empirical approaches to estimating the impact of permanent income on fertility suffer two serious problems. One is that of omitted variables. Education, occupation, and income are rarely included in the same model leaving open the possibility that effects attributed to the included variable are really due to the omitted components. Yet these are distinct aspects of SES with possibly distinct impacts on outcomes such as fertility. Furthermore, examination of the relationship between these aspects of permanent income will help us to understand their impacts on fertility.

The second serious limitation is the potential impact of measurement error in proxies for permanent income. Like omitted variables, this error can lead to mistakes in inferences about influences. Given its greater over time fluctuation than education and

occupation, it is particularly important that we distinguish transitory from permanent income. Though not always explicit, researchers seem to treat permanent income as more important than transitory income in predicting fertility behavior. Permanent income's latent nature presents special challenges to including it in empirical research. Scholars have responded to this challenge by using proxies of permanent income such as consumption or expenditure data and by using weighted and unweighted sums of asset data. Almost without exceptions, their models have not acknowledged permanent income's latent nature. That is, permanent income is a variable for which we have only indirect measures. Ultimately, our study aims to find answers to such problems and provide insight into how permanent income can be best operationalized in empirical research on developing countries.

## DATA

Our empirical analyses are based on data from two countries on different continents at quite different stages of development: Ghana and Peru. Ghana, which achieved independence from Britain in 1957, is one of the few Anglophone countries in the West African region. It is also one of the few in recent years to witness a peaceful democratic change of power. The Ghanaian economy, which is categorized by the World Bank as a lower income country with a per capita gross national income of only $340, has been undergoing a gradual transition to a market economy (World Bank 200x). Still, over 35% of Ghana's gross domestic product is associated with agriculture. Furthermore, a substantial number of rural households are self-reliant and not integrated into the market economy. Fertility in Ghana is still quite high, with today's total fertility rate (TFR) estimated at fewer than 4 children per women, but it has declined considerably from earlier levels of around 6.5 in 1980. The survey data for our analysis comes from

the Ghana Living Standards Survey (GLSS) collected in 1988 by the Ghana Statistical Service in conjunction with the World Bank. During that earlier period, Ghana's per capita GDP was slightly higher at $350. In addition, school enrollment levels for girls in primary school are now up to 74 percent, rising from levels estimated at 68 percent in 1990.

The second country in our study, Peru, has a per capita gross national income of $2080 and is included in the World Bank's category of middle-income countries. Peru's economy, even during the time of the survey (1985), is much more oriented towards industry, with less than 8 percent of the gross domestic product derived from agriculture. Fertility in Peru is also substantially lower than in Ghana. The TFR today is estimated at about 2.8 and it is estimated to have been about 4.5 in the late 1980s. Education levels are also much higher with essentially universal schooling of boys and girls at the primary level. Our analysis is based on the 1985 Peru Living Standards Survey (PLSS) collected by the Statistical Institute of Peru in conjunction with the World Bank.

Both the Ghana and Peru data sets are part of the World Bank's Living Standards Measurement Study (LSMS). LSMS surveys are ideal for our study because they contain detailed socioeconomic data on households and individuals, and some of them include fertility data. We chose these particular LSMS data sets because they represent countries in different regions and at different stages of development, and they both included a fertility module.

A total of 3,192 households were interviewed in the GLSS; 5,107 households were interviewed in the PLSS. Both surveys employed stratified random sampling to attain representative samples. (For further details see World Bank [1993a; 1993b]) Both surveys randomly selected a woman between the ages of fifteen and fifty from each household where there was one. We omitted women who had never been married or

cohabited with a man. We also omitted women from households where there was no male head of household. A male head of household was identified either by (1) being labeled as the head in the data and being male or (2) being the spouse of a woman identified as the head of household. This restriction enables us to include male head's education and occupational status, important components of the household's permanent income, in our model. Thus, our results are only generalizeable to these populations of Ghanaian and Peruvian women. Our final samples include 1,376 women in Ghana and 2,548 women in Peru.[1]

*Variable definitions*

Our interest in permanent income, which is relatively consistent across the lifecourse, leads us to employ a cumulative measure of childbearing, children ever born (CEB). A further advantage of using CEB as our outcome variable is that many studies of fertility employ this measure, and consequently our results are more readily comparable to more research than they would be if we used a different measure of fertility.

The detailed nature of the LSMS surveys allows us to measure many different aspects of permanent income. Table 1 organizes the permanent income variables into two types. The first are variables that are determinants of permanent income and the second are effected by permanent income.

We begin with a description of the various determinants of permanent income, which are listed in the first column of Table 1. Both female and male head's **educational status** are included as a series of dichotomous variables indicating the highest level of

[1] For Ghana, of the 3,192 households in the sample, 847 had no women between the ages of fifteen and fifty. Seventy-five additional women were missing from the fertility module. An additional 47 cases were missing on individual variables. For Peru, of the 5,107 households in the sample, 907 had no women between the ages of fifteen and fifty. Eighty-three women were missing from the fertility module and 132 had missing values on individual variables.

education achieved. These include primary, middle, and secondary or greater, with none as the reference category.[2] Second, the head of the household's **occupational status** is measured using Treiman's (1977) international occupational prestige score. Because the occupational prestige score may miss the distinctive aspects of being a farmer in poor rural settings, we also include a dummy variable for being a farmer.

**Table 1. Classification of the Measures of Permanent Income**

| Determinants of Permanent Income (Causal Indicators) | Effects of Permanent Income (Effect Indicators) |
|---|---|
| Male head's educational attainment | Log of household expenditures per adult |
| Female's educational attainment | Ownership of consumer durable goods (several different approaches to constructing index) |
| Male head's occupational status:<br>Treiman's occupational prestige<br>Farmer | Housing quality |

The second column of Table 1 lists variables that "reflect" or are "effect" indicators of permanent income. One of these is the **log of household expenditures** per adult. Stocks of assets owned by the household must be converted into a measure of the flow of services the assets provide to the household. The estimate of the flow of services is then used to adjust the estimate of household expenditures. We also adjust this measure for regional variations in price and inflation during the time of data collection.[3] In Ghana the units are expressed in cedis, and in Peru they are expressed in intis. In 1988

[2] We do not use a category for secondary or higher schooling for females in Ghana because less than 3% of the sample had this much education.

[3] For the GLSS we obtained the regional and monthly inflation adjustments from the basic information document provided by the World Bank (1993a). For the PLSS we obtained the regional price deflators from Glewwe (1987) and the monthly adjustments from Webb and Baca de Valdez (1991).

the exchange rate was 188 cedis for one U.S. dollar, and in 1985 the exchange rate was 10.98 intis for one U.S. dollar.

Information about the ownership of a long list of **consumer durable goods**, such as a cassette player or a stove, was collected in both surveys.[4] This information allows us to assess a number of different effect indicators of permanent income. Our analyses compare four different approaches to combining these assets, which we describe below.

1. *Simple sum*. One measure is the sum of the number of goods owned by the household, which is the most common approach to constructing an index of consumer durable goods.
2. *Current value sum*. In both surveys respondents were asked how much they believe they could sell each consumer durable good owned by the household at the time of the survey. Therefore, our second approach to combining the information about assets is a sum of the respondents' estimates of the current values of the goods owned by their households.
3. *Median value sum*. We expect that the answers to the reported value of goods may be highly variable, particularly in settings where no market exists for the goods. Therefore, our third approach estimates the values of all goods owned by the household as the median value reported for all households that owned that particular item. We construct this measure by summing the median values of the items owned by the households.
4. *Principal components score*. Following Filmer and Pritchett (1999; 2001) a final approach we use is the first principal components score for the items

[4] For the GLSS the full list is: sewing machine, stove, refrigerator or freezer, air conditioner, fan, radio, cassette player, phonograph, stereo equipment, video equipment, washing machine, black and white television, color television, bicycle, motorbike, car, and camera. For the PLSS the full list is: radio; refrigerator; sewing machine; car; bicycle; floor polisher; telephone; black and white television; color television; washing machine; knitting machine; motorcycle; record player or other sound equipment, blender, mixer or fan; and gas stove.

owned by the household. Principal components involves estimating a linear combination of the separate components such that the maximum of the common variance is explained and using the estimated "coefficients" as weights. The use of principal components allows each item to have a different weight, but the weight is based on the results of the principal component analysis rather than any information on the actual reported value of each of the assets. The first component captured about 24 and 32 percent of the variation in the consumer durable goods items for Ghana and Peru respectively.[5]

We construct measures corresponding to these four approaches based on the consumer durable good items available in the LSMS data sets.[6] Because they are highly skewed and have outliers, we log all of the asset measures.[7]

Our final effect indicator of permanent income is an index of **housing quality**. The index includes the presence of a flushing toilet, piped water, electricity, non-dirt floor, and more than one room in the dwelling. To maintain consistency with the scaling for the other items we code the number of rooms in the dwelling as an indicator variable. In the GLSS the variable distinguishes between one room and more than one room. About forty percent of the sample had only one room. In the PLSS we code this variable

[5] The weights in Ghana are as follows: sewing machine .183, gas stove .280, refrigerator or freezer .370, air conditioner .067, fan .317, radio .089, radio/cassette player .241, phonograph .159, stereo equipment .316, video equipment .322, washing machine .089, black and white television .307, color television .286, bicycle .008, motorbike .044, car .283, camera .292. The weights in Peru are as follows: radio .062, refrigerator .352, sewing machine .216, car .264, bicycle .176, floor polisher .315, telephone .279, black and white television .210, color television .323, washing machine .318, knitting machine .109, motorcycle .065, record player or sound equipment .261, blender mixer or fan .339, gas stove .315.

[6] We also construct measures that include only the consumer durable goods that are available in the DHS—radio, television, refrigerator, bicycle, motorcycle, and car. By comparing the performance of the measures based on the full set of items to the measures based on the DHS items, we can evaluate whether collecting information about a longer list of durable goods creates a more reliable proxy for permanent income. We return to this question in the conclusion.

[7] For each we added '1' before logging except for the principal components score where we added a constant value so that no values were '0' or negative.

as 2 or less rooms and more than 2 rooms. About 50 percent of the sample had 2 or fewer rooms.

The control variables include religion, ethnicity, region, urban/rural, and age. Some of these variables, such as place of residence, Friedman (1957) identifies as determinants of permanent income. In addition, many of variables are likely to influence both permanent income and fertility and are therefore included as controls. For example, ethnicity and religion are likely to capture important differences in cultural values that may affect permanent income standing or fertility. Each of the control variables as well as its reference category is listed below in Table 2.[8]

**Table 2. Description of Control Variables**

| | **GLSS** | **PLSS** |
|---|---|---|
| **Foreign** | Equals 1 if head of hhld. was born out of the country | Equals 1 if head of hhld. was born out of the country |
| **Religion** | Catholic, other Christian, Moslem, other religion, and traditional religion (reference) | |
| **Ethnicity** | Ewe, Gaadang, Akan, other ethnicity (reference) | Equals 1 if interview was conducted in an indigenous language |
| **Place of residence** | Ecological zones: coast, greater Accra, forest, and savannah (reference)<br><br>Urban, semi-urban, and rural (reference) | Ecological zones: northern coast, southern coast, Lima (reference), northern mountain, central mountain, southern mountain, jungle<br><br>Urban and rural (reference) |
| **Woman's age** | 15-19 (reference), 20-24, 25-29, 30-34, 35-39, and 40-50 | 15-19 (reference), 20-24, 25-29, 30-34, 35-39, and 40-50 |

[8] Descriptive statistics are available from the authors upon request.

LATENT VARIABLE MODELS

As we described in the previous section, it is important to distinguish between *causal indicators*, which affect the latent variable, and *effect indicators*, which are determined by the latent variable (see Bollen and Lennox 1991). Education and occupational status are important causal indicators of permanent income. In Friedman's conceptualization, education is an attribute that influences one's capacity to generate income, so it makes more sense that education determine permanent income rather than vice versa. Occupational status is also an attribute that influences earning potential. Similarly, both residence and ethnicity might be considered causal factors. Persons who live in more developed places should have a higher income than those who live in less developed areas. Finally, ethnic stratification has implications for economic chances, and foreigners generally have lower economic status in Ghana and higher status in Peru. In contrast, the other indicators of permanent income, expenditures, ownership of consumer durable goods, and housing quality are likely to be effect indicators of permanent income.

The equations for this model have the form of:

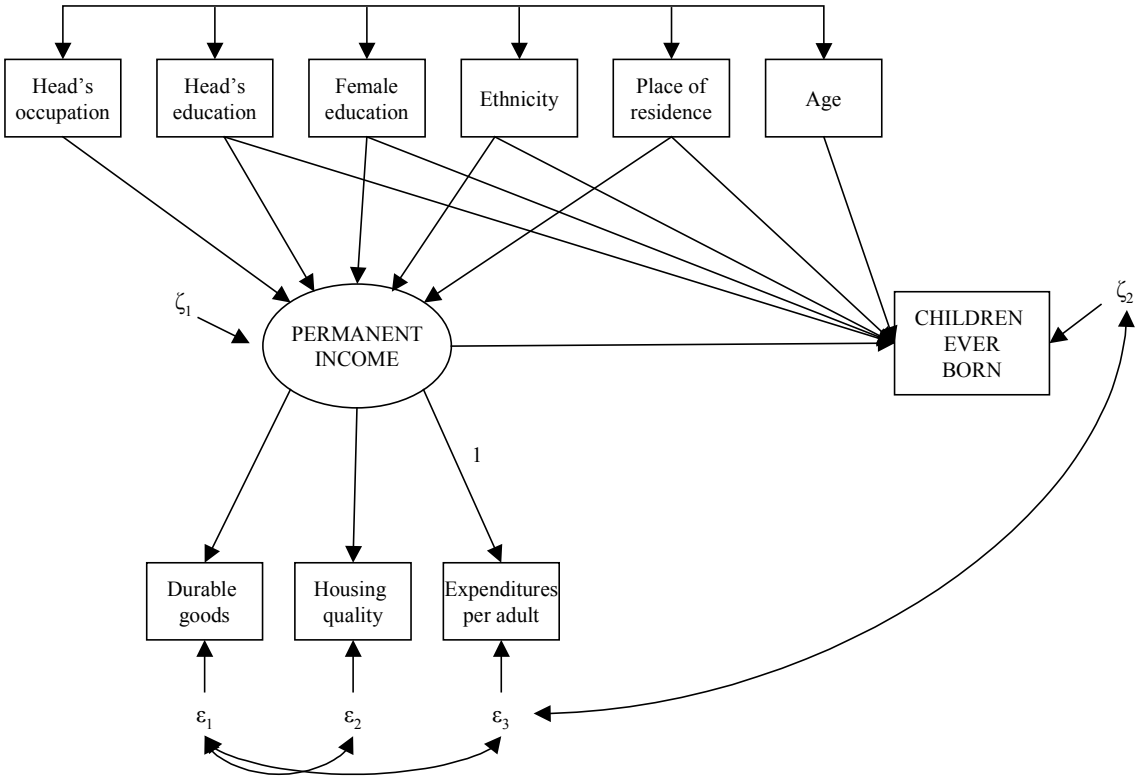
$$y_j = \alpha_{yj} + \lambda_j \eta + \varepsilon_j$$
$$\eta = \alpha_\eta + \Gamma_1 \mathbf{x}_1 + \zeta_1$$
$$F = \alpha_F + \beta \eta + \Gamma_2 \mathbf{x}_2 + \zeta_2$$

where $y_j$ represents the effect indicators of permanent income ($\eta$) with j=1, 2,…, J, the number of indicators, $\alpha_{yj}$ is the intercept for the jth indicator equation, $\lambda_j$ is the coefficient of the impact of the latent permanent income variable ($\eta$) on the jth indicator, $\varepsilon_j$ is a random measurement error with $E(\varepsilon_j)=0$ and $COV(\varepsilon_j, \eta)=0$. The second equation has the permanent income ($\eta$) as the latent dependent variable, $\alpha_\eta$ is the intercept, $\mathbf{\Gamma_1}$ is the row

vector of coefficients for the exogenous variables included in $\mathbf{x_1}$, and $\zeta_1$ is the equation disturbance with $E(\zeta_1)=0$, $COV(\zeta_1, \mathbf{x_1})=0$, and $COV(\zeta_1, \varepsilon_j)=0$. The children ever born (F) is the final equation where $\alpha_F$ is the intercept term, $\beta$ is the regression coefficient for permanent income's effect on F, $\mathbf{\Gamma_2}$ is the coefficient matrix for the exogenous variables ($\mathbf{x_2}$) in the equation, and $\zeta_2$ is the equation disturbance with $E(\zeta_2)=0$, and $COV(\zeta_2, \mathbf{x_2})= COV(\zeta_2, \mathbf{x_1})=0$. There is some overlap in the variables in $\mathbf{x_1}$ and $\mathbf{x_2}$. We also assume that $COV(\zeta_1, \mathbf{x_2})=0$, $COV(\zeta_2, \zeta_1)=0$, and $COV(\zeta_2, \varepsilon_j)=0$, except for the covariance between the error terms of fertility and expenditures. We allow the errors of the expenditure variable and the consumer durable good variable to correlate because the rental value of the durable goods is used in the construction of the expenditure variable. Finally, we allow the errors between the consumer durable goods variable and housing quality to correlate because many of the durable goods depend on the presence of electricity that is a part of the housing quality index. Figure 1 shows the path diagram for this model.[9] We also allow for urban and suburban residence to have direct effects on housing quality and consumer durable goods since electricity is dependent upon community infrastructure (i.e., place of residence has direct paths to "durable goods" and "housing quality" though the paths are not shown in figure).

[9] In path diagrams latent (unobserved) variables are represented with oval and observed variables are represented with boxes. Straight one-headed arrows designate direct causal relationships. A curved two-headed arrow stands for a covariance between two variables that is not explained by the model. Usually, the exogenous variables in a model are intercorrelated which we represent in the diagram by curved, two-headed arrows.

**Figure 1. Path Diagram of Latent Variable Model**




There are several questions that this type of modeling allows us to address. First, we assess whether it makes sense to treat permanent income as a latent variable. Our model has this latent variable mediating the effect of some variables and explaining the association of other variables. If the latent variable is not needed, then the fit of this model to the data will be poor in that the path from permanent income will be statistically insignificant and the R-squares of durable goods, housing quality, and expenditures per adult will be low.

Second, this approach enables us to distinguish between direct and indirect effects in terms of the components of SES. For example, we can test whether the effect of female education is completely mediated by its influence on permanent income or whether it also has a direct effect on fertility, a question that has motivated considerable

research (e.g., Cleland and Rodriguez 1988; Martin and Juarez 1995; Rodriguez and Cleland 1981). Cleland and Rodriguez (1988) and Rodriguez and Cleland (1981) were not able to include income or permanent income in their analyses. Martin and Juarez (1995) included a measure using consumer durable goods, but did not account for the measurement error in this proxy.

Third, we determine which of the permanent income indicators most reliably measure permanent income. We do this by comparing the squared correlation of the indicator variables with permanent income. A greater correlation suggests a closer relation between the indicator and permanent income. This result is important because it provides information on which measure is preferable to collect in surveys in order to help reduce the length of survey questionnaires while maximizing the accuracy of income measures. Because we want to evaluate several different ways of constructing measures based on the consumer durable goods items, we estimate separate models for each of the four approaches.

## RESULTS

Our discussion of the results is organized as follows. First, we describe the results of the latent variable models for both countries. Second, we assess which of the permanent income indicators most reliably measure permanent income. Third, we compare how the results differ when measurement error is taken into account versus when a proxy for economic status is used. We evaluate the differences in results for the predicted effects of permanent income and of the other explanatory variables in the model.

*Latent Variable Models*

Table 3 summarizes the results of the latent variable models for both Ghana and Peru. In the model displayed here, ln expenditures per adult, the housing quality index, and ln principal components score are the three effect indicators of permanent income.[10] Over-identified latent variable models such as ours have measures of overall fit that provide information on testing the over-identifying restrictions (Bollen 1989, Ch.7). The fits of the models are quite good. For both countries the Chi-square is statistically significant, but with so many cases there is enough power to detect even minor deviations from the true model (Bollen 1989: 268). As shown at the bottom of Table 2, other measures of fit, the Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and the Root Mean Squared Error of Approximation (RMSEA), show a good fit (Bollen and Long 1993). Given this good fit, we now discuss the coefficient estimates.

[10] For models that use a different durable goods effect indicator we summarize the factor loadings, standard errors, standardized factor loadings, and reliabilities in Table 4.

**Table 3. Parameter Estimates for the Latent Variable Model**

| | | Ghana[a] | | | Peru[b] | |
|---|---|---|---|---|---|---|
| **Predicted variable** | **Explanatory variable** | **Coefficient** | **SE** | | **Coefficient** | **SE** |
| **Permanent Income** | | | | | | |
| | *Education* | | | *Education* | | |
| | Female primary | 0.011 | 0.022 | Female primary | 0.090 *** | 0.024 |
| | Female greater than primary | 0.095 *** | 0.022 | Female secondary | 0.277 *** | 0.032 |
| | | | | Female greater than 2nd. | 0.495 *** | 0.045 |
| | Male primary | 0.003 | 0.027 | Male primary | 0.123 *** | 0.033 |
| | Male middle | 0.067 ** | 0.022 | Male secondary | 0.223 *** | 0.039 |
| | Male secondary or greater | 0.223 *** | 0.038 | Male greater than 2nd. | 0.400 *** | 0.048 |
| | *Occupation* | | | *Occupation* | | |
| | Occupational prestige | 0.005 *** | 0.001 | Occupational prestige | 0.008 *** | 0.001 |
| | Farmer | -0.127 *** | 0.021 | Farmer | -0.178 *** | 0.026 |
| | *Place of residence* | | | *Place of residence* | | |
| | Urban | 0.160 *** | 0.038 | Urban | 0.037 | 0.038 |
| | Semi-urban | -0.009 | 0.039 | | | |
| | Coast | 0.076 ** | 0.028 | Northern coast | -0.303 *** | 0.027 |
| | Greater Accra | 0.312 *** | 0.044 | Southern coast | -0.073 * | 0.032 |
| | Forest | 0.016 | 0.026 | Northern mountain | -0.335 *** | 0.036 |
| | | | | Central mountain | -0.282 *** | 0.031 |
| | | | | Southern mountain | -0.316 *** | 0.035 |
| | | | | Jungle | -0.325 *** | 0.044 |
| | *Ethnicity* | | | | | |
| | Ewe | -0.048 + | 0.028 | Indigenous language | -0.119 ** | 0.039 |
| | Gaadang | -0.021 | 0.040 | | | |
| | Akan | 0.019 | 0.025 | | | |
| | Foreign | -0.036 | 0.039 | Foreign | 0.311 * | 0.130 |
| **Children Ever Born** | | | | | | |
| | *Socioeconomic* | | | *Socioeconomic* | | |
| | Permanent income | -2.421 *** | 0.709 | Permanent income | -2.016 *** | 0.366 |
| | Female primary | -0.074 | 0.146 | Female primary | -0.608 *** | 0.137 |
| | Female greater than primary | -0.335 * | 0.158 | Female secondary | -1.168 *** | 0.210 |
| | | | | Female greater than 2nd. | -1.590 *** | 0.304 |
| | Male primary | 0.083 | 0.175 | Male primary | 0.562 ** | 0.181 |
| | Male middle | 0.302 + | 0.157 | Male secondary | 0.580 * | 0.227 |
| | Male secondary or greater | 0.537 + | 0.305 | Male greater than 2nd. | 0.899 ** | 0.313 |

**Table 3. Parameter Estimates for the Latent Variable Model, continued**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Children Ever Born, cont.** | | | | | | |
| | *Place of residence* | | | *Place of residence* | | |
| | Urban | 0.059 | 0.219 | Urban | -0.448 ** | 0.142 |
| | Semi-urban | 0.116 | 0.169 | | | |
| | Coast | 0.504 ** | 0.193 | Northern coast | -0.281 | 0.172 |
| | Greater Accra | 0.925 ** | 0.343 | Southern coast | 0.224 | 0.172 |
| | Forest | 0.283 + | 0.171 | Northern mountain | -0.464 * | 0.223 |
| | | | | Central mountain | 0.055 | 0.189 |
| | | | | Southern mountain | -0.158 | 0.212 |
| | | | | Jungle | 0.192 | 0.254 |
| | *Age* | | | *Age* | | |
| | 20 to 24 | 1.118 *** | 0.185 | 20 to 24 | 1.300 *** | 0.236 |
| | 25 to 29 | 2.423 *** | 0.185 | 25 to 29 | 2.639 *** | 0.223 |
| | 30 to 34 | 3.837 *** | 0.190 | 30 to 34 | 3.716 *** | 0.224 |
| | 35 to 39 | 5.135 *** | 0.204 | 35 to 39 | 4.435 *** | 0.227 |
| | 40 to 50 | 6.528 *** | 0.198 | 40 to 50 | 5.411 *** | 0.223 |
| | *Ethnicity* | | | *Ethnicity* | | |
| | Ewe | -0.427 * | 0.188 | Indigenous language | -0.585 ** | 0.214 |
| | Gaadang | -0.431 | 0.264 | | | |
| | Akan | 0.034 | 0.165 | | | |
| | Foreign | 0.202 | 0.254 | Foreign | -0.440 | 0.708 |
| | *Religion* | | | | | |
| | Catholic | 0.038 | 0.162 | | | |
| | Other Christian | -0.022 | 0.150 | | | |
| | Moslem | 0.205 | 0.173 | | | |
| | Other religion | 0.418 + | 0.236 | | | |
| *Indicators of Perm. Income* | | | | | | |
| **Expenditures per adult** | | | | | | |
| | Permanent income | 1.000 | | Permanent income | 1.000 | |
| **Durables--pc score** | | | | | | |
| | Permanent income | 1.460 *** | 0.122 | Permanent income | 0.940 *** | 0.040 |
| | Urban | 0.127 + | 0.067 | Urban | 0.139 *** | 0.035 |
| | Semi-urban | 0.058 | 0.060 | | | |
| **Housing quality** | | | | | | |
| | Permanent income | 1.529 *** | 0.172 | Permanent income | 1.615 *** | 0.086 |
| | Urban | 0.778 *** | 0.095 | Urban | 1.082 *** | 0.074 |
| | Semi-urban | 0.223 ** | 0.084 | | | |
| Number of Cases | | 1376 | | | 2548 | |

We first consider the predictors of permanent income. Not surprisingly, both female and male education greater than primary school are strong predictors of permanent income in Ghana. In addition, higher occupational prestige generates higher permanent income and being a farmer is associated with lower income. Place of residence is also an important predictor of permanent income. Urban households have higher income than rural households, and residence in the coastal ecological zone and the Greater Acra region are associated with higher income than residence in the savannah ecological zone. Ethnicity does not seem to influence permanent income net of these other predictors. As in Ghana, female and male education and occupational status are significant predictors of permanent income in Peru. Urban residence does not significantly influence income, but residence in any ecological zone outside of Lima is a negative predictor of permanent income.

We now turn to the effects of the components of SES on children ever born. These results allow us to see the effect of the *latent* permanent income variable, rather than its proxies. In Ghana the estimated influence of permanent income on children ever born is about –2.4, which suggests that an increase in permanent income from the mean level to one standard deviation above the mean leads to an expected decrease of 1.4 children, holding all other explanatory variables constant. The magnitude and direction of influence of permanent income on children ever born is similar in Peru, where a 1 standard deviation increase in permanent income is associated with a 1.6 decrease in children ever born, holding all other explanatory variables constant. These findings suggest that permanent income has a strong negative influence on children ever born in both settings.

We also wanted to evaluate whether the other components of SES have a direct effect on fertility once their association with permanent income was introduced. Net of

permanent income, in Ghana female greater than primary education is a negative predictor of fertility. In Peru all levels of female education higher than 'none' (the reference category) are negatively related to fertility. In contrast, male education greater than 'none' has a significant and *positive* influence on fertility in Peru, and in Ghana the positive coefficient for male education is marginally significant. In other words, male and female education have the opposite influence on children ever born, once their influences on permanent income are taken into account.

In addition to male and female education, we also evaluated whether occupational status has an influence on fertility once its effect on permanent income is taken into account. To do so we compared a model that included direct paths from head's occupational prestige and farmer to fertility to a model that did not. If we find a significantly better fitting model by including these paths, then we have evidence supporting a direct effect from these variables to fertility. Alternatively a nonsignificant change in fit is consistent with no direct effects. Dropping these paths resulted in a Chi-square test of 3.79 for Ghana and 4.17 for Peru both with 2 degrees of freedom, which shows that removing the paths does not result in a significant loss of fit. Thus, the data clearly indicate that the effects of occupational prestige on fertility do not go beyond its effect on permanent income.

The next set of coefficients reported in Table 3 pertain to the predictors of permanent income's effect indicators. Permanent income is scaled to expenditures per adult so we do not interpret this coefficient. In both Ghana and Peru, the principal components score and housing quality index are positively influenced by permanent income. As expected, urban residence positively influences both indicators, net of its influence on permanent income. We next turn to a comparison of all of the effect indicators of permanent income.

*Assessing the Effect Indicators of Permanent Income*

Another desirable aspect of the structural equation latent variable model is that we can estimate the proportion of variance in the proxy variables that is due to error. Table 4 reports the coefficient estimates ("factor loadings"), asymptotic standard errors, standardized coefficients, and the squared correlations of the proxy variables with the permanent income latent variable. The higher the squared correlation, the stronger the association between permanent income and the proxy variable. Information like this helps in choosing measures in future studies. It also tells us the degree of error in our measures and the potential impact of treating these variables as if they were error free. Note that the expenditures and housing quality variables were effect indicators in all of the models, whereas each of the remaining variables were taken one at a time in separate models as the third indicator of permanent income.

**Table 4. Factor Loadings and Reliabilities for Permanent Income Effect Indicators**

| | Unstandardized Coefficient | S.E. | Standardized Coefficient | Squared Correlation with Income |
|---|---|---|---|---|
| **Ghana** | | | | |
| expenditures[a] | 1.000 | | 0.491 | 0.241 |
| housing quality[a] | 1.529 ** | 0.172 | 0.403 | 0.355 |
| simple sum | 1.312 ** | 0.125 | 0.568 | 0.348 |
| current value | 6.846 ** | 0.819 | 0.377 | 0.165 |
| median value | 6.567 ** | 0.816 | 0.363 | 0.156 |
| Principal components | 1.460 ** | 0.122 | 0.675 | 0.527 |
| DHS--simple sum | 0.837 ** | 0.103 | 0.463 | 0.150 |
| DHS--current value | 7.328 ** | 0.984 | 0.384 | 0.105 |
| DHS--median value | 6.223 ** | 0.925 | 0.330 | 0.068 |
| DHS--principal components | 1.136 ** | 0.108 | 0.598 | 0.369 |
| **Peru** | | | | |
| expenditures[a] | 1.000 | | 0.621 | 0.385 |
| housing quality[a] | 1.615 ** | 0.086 | 0.519 | 0.537 |
| simple sum | 0.913 ** | 0.042 | 0.611 | 0.467 |
| current value | 3.257 ** | 0.192 | 0.469 | 0.262 |
| median value | 3.171 ** | 0.175 | 0.509 | 0.335 |
| Principal components | 0.940 ** | 0.040 | 0.697 | 0.536 |
| DHS--simple sum | 0.567 ** | 0.030 | 0.530 | 0.384 |
| DHS--current value | 3.162 ** | 0.193 | 0.447 | 0.257 |
| DHS--median value | 3.263 ** | 0.176 | 0.506 | 0.372 |
| DHS--principal components | 0.710 ** | 0.032 | 0.610 | 0.529 |

** p<.01

[a] Estimates are for the full set principal components model.

In both countries all the effect indicators of permanent income have highly significant factor loadings. However, some of them have higher squared correlations with the latent permanent income variable than the others. (See Table 4.) The top four proxy variables with the highest squared correlations with permanent income in Ghana are the full principal components (0.53), the reduced DHS asset set[11] principal components (0.37), the housing quality index (0.36), and the simple sum of durable goods (0.35). Interestingly, the same top four indicators hold in Peru, though in a slightly different order, and their squared correlations are generally higher (0.54 to 0.47) than in

[11] The Demographic and Health Surveys (DHS) is another widely used survey for fertility and health studies. The reduced set of assets considered corresponds to those assets listed in the DHS which are typically fewer than the number listed in the LSMS surveys.

Ghana. These results suggest that the full principal component (and the DHS abbreviated form) measures are the best of the proxies in both countries with the housing quality and simple sum of assets next. Though we cannot know for sure that these same variables will perform similarly in other countries, it is impressive to see the proxies operating similarly across two very different countries.

The most information and calculation intensive measures are the expenditure, current value, and median value variables. These same indicators have lower squared correlations with permanent income than do the far easier to construct simple sum and principal components measures. The lowest correlations with permanent income occur for "DHS-median value" and "DHS-current value" in Ghana where the squared correlations are 0.10 or less so that 90% or more of the variance in these proxies is unassociated with permanent income. Even the best measure, the principal component variable in Peru, has over 40% of its variance unrelated to permanent income. The implication is that even the best of the proxies fall considerably short of measuring permanent income with negligible error.

*Comparison between Latent Variable and Proxy Approaches*

Thus far, our results have suggested that when permanent income is measured as a latent variable it has a strong negative influence on fertility and that various measures that are often employed as proxies for income contain a considerable amount of measurement error. Given these findings, it is important to ask whether the substantive conclusions drawn from our fertility model would be different if we followed the far more commonplace approach of measuring income with a proxy variable. In this section we describe the differences between our latent variable models and ordinary least squares models that use a proxy as the measure of permanent income. These proxy approaches

are the standard approach in the literature. We note differences in the estimated influences of both permanent income and of the other explanatory variables in the model.

Tables 5 and 6 display results from both the latent variable and the proxy approaches for Ghana and Peru respectively. In the latent variable model the permanent income variable has its metric set to be similar to that of the ln expenditures per adult variable, so it is useful to compare the results of this model to the proxy variable model where ln expenditures per adult is the proxy variable.

**Table 5. The Impact of Permanent Income and Control Variables on Number of Children Born in Ghana**

| | Latent Variable Model[a] | | Proxy (OLS) | |
|---|---|---|---|---|
| | **Coefficient** | **S.E.** | **Coefficient** | **S.E.** |
| *Economic resources* | | | | |
| Permanent income | -2.421 ** | 0.709 | | |
| Expenditures | | | 0.070 | 0.089 |
| *Female schooling* | | | | |
| Primary | -0.074 | 0.146 | -0.120 | 0.136 |
| Middle or greater | -0.335 * | 0.158 | -0.630 ** | 0.118 |
| *Male schooling* | | | | |
| Primary | 0.083 | 0.175 | 0.091 | 0.171 |
| Middle | 0.302 + | 0.157 | 0.109 | 0.145 |
| Secondary or greater | 0.537 + | 0.305 | -0.263 | 0.201 |
| *Place of residence* | | | | |
| Urban | 0.059 | 0.219 | -0.457 ** | 0.137 |
| Semi-urban | 0.116 | 0.169 | 0.077 | 0.151 |
| Coast | 0.504 ** | 0.193 | 0.310 † | 0.185 |
| Greater Accra | 0.925 ** | 0.343 | 0.135 | 0.250 |
| Forest | 0.283 + | 0.171 | 0.281 † | 0.145 |
| *Age* | | | | |
| 20 to 24 | 1.118 ** | 0.185 | 1.133 ** | 0.096 |
| 25 to 29 | 2.423 ** | 0.185 | 2.416 ** | 0.117 |
| 30 to 34 | 3.837 ** | 0.190 | 3.847 ** | 0.141 |
| 35 to 39 | 5.135 ** | 0.204 | 5.101 ** | 0.218 |
| 40 to 50 | 6.528 ** | 0.198 | 6.511 ** | 0.203 |
| *Ethnicity* | | | | |
| Ewe | -0.427 * | 0.188 | -0.306 | 0.186 |
| Gaadang | -0.431 | 0.264 | -0.354 | 0.274 |
| Akan | 0.034 | 0.165 | -0.008 | 0.157 |
| Foreign | 0.202 | 0.254 | 0.292 | 0.267 |
| *Religion* | | | | |
| Catholic | 0.038 | 0.162 | 0.015 | 0.150 |
| Other Christian | -0.022 | 0.150 | -0.052 | 0.161 |
| Moslem | 0.205 | 0.173 | 0.138 | 0.181 |
| Other religion | 0.418 + | 0.236 | 0.420 * | 0.186 |
| *Constant* | | | -0.125 | 0.984 |
| $R^2$ | 0.617 | | 0.599 | |
| Cov(expend, fertility) | 0.083 ** | 0.027 | | |
| Cov(expend, princomp) | 0.056 ** | 0.007 | | |
| Cov(hsg, princomp) | 0.083 ** | 0.012 | | |
| Number of Cases | 1376 | | 1376 | |

[a]Chi-square=242.394, DF=56, IFI=.995, TLI=.961, CFI=.995, RMSEA=.049

**p<.01, *p<.05, +p<.10

The most dramatic difference is that in the latent variable model, the effect of permanent income on fertility is large, negative, and highly statistically significant,

whereas in the proxy model the predicted influence of income is not statistically significant and has the opposite sign. This illustrates a fundamental shift in the conclusion about whether permanent income negatively influences fertility. When we treat ln expenditures as a proxy of permanent income, we conclude that there is no effect. Yet when we take account of the measurement error in ln expenditures as an indicator of permanent income, we find a substantial negative estimate for permanent income. We also estimated an OLS model with the full set principal components score, the proxy our latent variable models indicate most closely captures permanent income. In this comparison, we find a much larger estimated influence of permanent income in the latent variable model, though the coefficient for this proxy is negative and statistically significant. (Results available from authors upon request.)

The differences extend beyond the assessment of the influence of permanent income. For instance, the -0.63 estimate of the direct effect of "female middle or more schooling" drops to -0.35 (over a forty percent reduction) when measurement error is treated. The direct effect of urban residence is 0.06 in the latent variable model, whereas in the proxy model it is -.46 and statistically significant. This is not due to the fact that in our latent variable model we separate the direct and indirect effects of the variables that influence both permanent income and fertility (e.g., maternal education). In the proxy approach the coefficients of these variables should be viewed as direct effects because their correlations with (and therefore potential indirect effects on) the proxy for permanent income are taken into account. While the coefficients of some variables in the model change a good deal, others are more stable. In particular, the age variable effects are very similar across the two models.

**Table 6. The Impact of Permanent Income and Control Variables on Number of Children Born in Peru**

| | Latent Variable Model[a] | | Proxy (OLS) | |
|---|---|---|---|---|
| | Coefficient | S.E. | Coefficient | S.E. |
| *Economic resources* | | | | |
| Permanent income | -2.016 ** | 0.366 | | |
| Expenditures | | | -0.078 | 0.076 |
| *Female schooling* | | | | |
| Primary | -0.608 ** | 0.137 | -0.867 ** | 0.157 |
| Secondary | -1.168 ** | 0.210 | -1.875 ** | 0.171 |
| More than secondary | -1.590 ** | 0.304 | -2.751 ** | 0.192 |
| *Male schooling* | | | | |
| Primary | 0.562 ** | 0.181 | 0.349 + | 0.197 |
| Secondary | 0.580 * | 0.227 | 0.122 | 0.219 |
| More than secondary | 0.899 ** | 0.313 | -0.064 | 0.237 |
| *Place of residence* | | | | |
| Urban | -0.448 ** | 0.142 | -0.635 ** | 0.13 |
| Northern coast | -0.281 | 0.172 | 0.324 * | 0.142 |
| Southern coast | 0.224 | 0.172 | 0.372 * | 0.184 |
| Northern mountain | -0.464 * | 0.223 | 0.247 | 0.196 |
| Central mountain | 0.055 | 0.189 | 0.682 ** | 0.154 |
| Southern mountain | -0.158 | 0.212 | 0.517 ** | 0.19 |
| Jungle | 0.192 | 0.254 | 0.815 ** | 0.182 |
| *Age* | | | | |
| 20 to 24 | 1.300 ** | 0.236 | 1.284 ** | 0.145 |
| 25 to 29 | 2.639 ** | 0.223 | 2.585 ** | 0.145 |
| 30 to 34 | 3.716 ** | 0.224 | 3.597 ** | 0.159 |
| 35 to 39 | 4.435 ** | 0.227 | 4.263 ** | 0.178 |
| 40 to 50 | 5.411 ** | 0.223 | 5.18 ** | 0.183 |
| *Ethnicity* | | | | |
| Indigenous language | -0.585 ** | 0.214 | -0.432 | 0.289 |
| Foreign | -0.440 | 0.708 | -0.973 ** | 0.304 |
| *Constant* | | | 2.216 ** | 0.48 |
| $R^2$ | 0.500 | | 0.466 | |
| Cov(expend, fertility) | 0.081 | 0.025 | | |
| Cov(expend, princomp) | 0.025 | 0.009 | | |
| Cov(hsg, princomp) | 0.088 | 0.015 | | |
| Number of Cases | 2548 | | 2548 | |

[a]Chi-square=505.197, DF=48, IFI=.993, TLI=.950, CFI=.993, RMSEA=.061

**p<.01, *p<.05, +p<.10

In Table 6 we contrast the results of the latent variable model to those of the proxy model with ln expenditures for Peru. Once again we find that permanent income's coefficient estimate is quite different in the model that controls for measurement error

than in the one where ln expenditures per adult is entered as a proxy variable. Furthermore, the attenuation in the coefficient estimates for female education that occurred for Ghana occurs here as well with fairly large percentage drops in their magnitude in the latent variable model. The coefficient for urban residence is also smaller in magnitude in the latent variable model. We also note that several of the regional variables that are statistically significant in the proxy variable model are not significant in the latent variable model. Similar to our analysis of Ghana, the impact of the age variables differs little between the latent variable and proxy variable models.

The role of male schooling presents another interesting issue. Various authors have used male schooling to proxy for permanent income or SES (i.e. Wood and Lovell 1992; Raftery, Lewis, and Aghajanian 1995). Here, we see that while male schooling appears to have no impact in the proxy variable models, the magnitude of its coefficient becomes larger in the latent variable models in both countries. In Ghana male schooling becomes marginally significant in the latent variable model, and in Peru, male schooling becomes significant. Interestingly, we see that the "no effect" result in the proxy model is likely due to what we find in the latent variable model: male schooling positively affects permanent income yet has a negative direct effect on children ever born. The direct and indirect effects cancel each other out. By constructing a latent variable model to represent permanent income, we uncover this interesting direct effect on fertility. This result may support research indicating that in developing countries, especially in Sub-Saharan Africa, men tend to want more children than women (Bankole and Singh 1998). Higher male education (controlling for female education level and for household permanent income) may indicate their greater relative power within the household and hence their ability to impose more favorable (higher) childbearing patterns. In contrast,

higher female education (controlling for male education and household permanent income) may indicate more autonomy for women to control their fertility (Balk 1994).

Overall, we find that substantial differences in our results occur when we account for the measurement error in the measures of permanent income. First, we find a very different impact of permanent income on children ever born. Second, we find that the error in the proxy variables leads to inaccurate estimates of several of the control variables even when these controls are free of measurement error. Given the dominance of the proxy variable approach to measuring permanent income in fertility models, this is an important result that suggests that researchers should not ignore measurement error in their proxy variables. Nevertheless, when proxy variable models are adopted, our results suggest that the principle components approach is the preferred approach of estimating the appropriate weights for each of the included items.

## CONCLUSIONS

The past few years have seen a resurgence of interest in the importance of long term economic status, such as wealth and permanent income, in sociology. We concur that long-term economic status is important, but also call attention to the fact that permanent income is inherently difficult to measure, particularly in developing countries. Developing adequate measurement strategies is a fundamental step in understanding how long-term status matters for a variety of outcomes, including fertility.

Our analyses question the conventional approach of using proxy variable analyses to assess the impact of permanent income on fertility. Despite finding evidence that the principal components score and the simple sum proxies are better than others, our latent variable models demonstrate that this approach is hardly ideal. Even the best indicator of permanent income contains a good deal of measurement error. This measurement error

can bias both the coefficient of the variable measured with error and the other coefficients in the model. Indeed, we saw this happen in our analyses for both Ghana and Peru. The estimated impact of income was much larger in the latent variable models, and the coefficients for some of the control variables were influenced by measurement error. Therefore, in terms of how the measurement of income is best incorporated into models, our results indicate that it is preferable to use latent variable techniques.

From the perspective of data collection we also have recommendations. Depending on one's purposes, it may not be useful to collect information on the value of durable goods and expenditures. We found that these indicators performed much worse than the simple sum and principal components scores. This could be for several reasons. First, respondents may be unable to realistically estimate the value of their goods, and it may be particularly difficult to estimate the value of goods and services that are acquired through non-market channels. Consequently, these responses are likely to contain a large amount of error. Second, there can be a great deal of regional price variation and inflation as was the case for the countries in our study. Although adjustments for these variations can and should be made, this is a lengthy process that depends on obtaining rather extensive information on price deflators and making assumptions along the way. For example, in Peru monthly price information is only available for the 13 major cities. Therefore, the researcher wishing to adjust the value of goods and expenditures must assume that the areas surrounding the cities for which the information on prices is available should be adjusted in the same way. If the purpose is evaluating program effects on fertility and other outcomes such as child mortality, it hardly seems worth the effort to collect detailed data on expenditures and the value of durable goods, especially since these measures do not even perform as well as other information that is collected more easily.

We also wanted to evaluate whether collecting information on a long list of consumer durable goods results in a more accurate measure of income than the shorter list that is available in the DHS. On this question, we are unable to reach a conclusion as easily because we found that it made a rather large difference in Ghana, while in Peru the full set measures were not consistently better than their DHS counterparts. This may imply that in very undeveloped contexts where hardly any durable goods are owned and there is thus less variance across households, such as in Ghana, it may make more of a difference than in relatively more developed contexts, such as Peru. However, further research will have to determine whether this finding generalizes to other settings.

Overall, we find that permanent income is an important determinant of fertility and that how it is measured influences the substantive conclusions that researchers will draw from their analyses. Therefore researchers should be careful to measure it adequately whether they are interested in the effect of income itself or in the effect of some other variable such as the placement of fertility clinics. Our study provides some guidelines on how to operationalize permanent income in studies of fertility as well as other demographic and non-demographic outcomes.

Finally, stratification research continues to question whether individual components such as education, occupation, ethnicity, etc. act as a single general factor in determining life chances and other outcomes or if they act as distinct components. Much of the evidence from the stratification literature points toward the distinct component view. However, our paper paints a more complex picture. Permanent income is shown to be a general characteristic of stratification with a substantial impact on fertility in both Ghana and Peru. At the same time some separate components of stratification (e.g., female education) demonstrate distinct effects on fertility beyond their effects on permanent income. Other variables such as occupation have their effects on fertility

totally mediated through permanent income. Thus, there is support for the separate effects of components of SES and permanent income as well as these factors coalescing in a more global concept with strong effects not captured by the individual components. We speculate that the concept of permanent income will be useful in the study of other outcomes in other contexts.

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